

REMARKS

Claims 1-22 are pending in this application.

Claims 1, 7-8, 14-15 and 19 are independent.

Claims 1-22 stand rejected under 35 U.S.C. §103(a) as obvious over Hatano et al. (U.S. Patent No. 5,079,184) in view of Sasaki et al. (U.S. Patent No. 6,246,078). The rejection is respectfully traversed.

Each of independent claims 1, 7-8, 14-15 and 19 requires an insertion layer which is inserted between the p-type cladding and window layers (or optionally into the p-type cladding layer in the case of claims 15 and 19), and which in the case of claims 1, 7-8 and 14 has a smaller band gap energy than that of the p-type cladding layer, or in the case of claims 15 and 19 is lattice matched with and has a lower composition of Al than the p-type cladding layer and a higher composition of Al than the active layer.

The Examiner points to Figure 3, column 5, line 59 et seq., of Hatano as disclosing a P-intermediate layer 47 having a band gap greater than the active layer 45 and less than the clad layer 46. The Examiner notes that the layer 47 has been construed to be formed by $\text{In}_{0.5}\text{Ga}_{0.4}\text{Al}_{0.1}\text{P}$, on the basis that Hatano discloses, in column 10, line 13, that Al of layer 47 is low.

However, as explicitly disclosed in column 6, lines 6-14, layer 47 is a clad layer formed of $\text{In}_{0.5}\text{Ga}_{0.5}\text{Al}_{0.1}\text{P}$ and serves as an etch-stopping layer. As best can be determined from Hatano's description, the low Al of layer 47 relates only to the difference between the Al content of clad layer 47 and clad layers 46 and 48. It is respectfully submitted that there is nothing within Hatano's explicit disclosure to suggest otherwise, or to suggest that Hatano's reference to the low Al

content in layer 47 indicates an error in Hatano's explicitly disclosure of the Ga content in layer 47. Accordingly, it is respectfully submitted that Hatano, and hence the applied combination of art, lacks any suggestion of a layer either (i) disposed between a P-type cladding layer and p-type window layer which has a smaller band gap energy than the p-type cladding layer, as required by claims 1, 7-8, and 14, or (ii) disposed between p-type cladding and window layers or in the p-type cladding layer and lattice matched with and having a lower composition of Al than that in the p-type cladding layer and a higher composition of Al than the active layer, as required by claims 15 and 19.

Furthermore, contrary to the Examiner's contention, layer 47 of Hatano's Fig. 3 is not a p-insertion layer, but is expressly disclosed to be part of the cladding layer structure. As described by Hatano in column 6, lines 12 to 14, the $\text{In}_{0.5}\text{Ga}_{0.5}\text{Al}_{0.1}$ P layer 47 is a clad layer which is provided solely for the purpose of etch stopping. It is accordingly respectfully submitted, that Hatano's clad layer 47 is not intended or disclosed to reduce the discontinuity of the energy bands caused by the differences in the affinity for electrons between a cladding layer and a window layer, but is part of the cladding layer structure itself. Thus, there is nothing to suggest that Hatano's layer 47 has, or could have, a smaller band gap energy than a p-type cladding layer, as required by claims 1, 7-8, and 14, or be lattice matched with and have a lower composition of Al than a p-type cladding layer and a higher composition of Al than an active layer, as required by claims 15 and 19.

On the other hand, the insertion layer of the present invention serves as a forward voltage reducing layer. More

particularly, the recited insertion layer of claims 1, 7-8 and 14 is formed between a p-type cladding layer and a window layer and has a smaller band gap energy than the p-type cladding layer, and the recited insertion layer of claims 15 and 19 is formed between p-type cladding and window layers, or in the p-type cladding layer, and is lattice matched with and has a lower composition of Al than the p-type cladding layer and has a higher composition of Al than the active layer. Therefore, the invention of claims 1, 7-8, 14-15 and 19 prevents a high potential barrier between the p-cladding layer and the window layer. Accordingly, the forward voltage can be lowered.

In summary, layer 47 (the etch stopping layer) of Hatano does not serve as a forward voltage reducing layer. Rather, layer 47 is part of a p-type cladding layer structure itself. Clad layer 47 does not have the smaller band gap energy required by claims 1, 7-8 and 14, and does not have the lattice matching with and the lower and higher compositions of Al required by claims 15 and 19. Therefore clad layer 47 does not prevent a high potential barrier between the p-cladding layer and the window layer, or facilitate the lowering of a forward voltage in Hatano's laser. Hence, Hatano's layer 47 does not accomplish objective(s) of the present invention.

Additionally, as recognized by the Examiner, Hatano does not utilize a window layer. Hence, Hatano does not even consider the differences in the affinity for electrons between a cladding layer and a window layer. Accordingly, Hatano has no need to form layer 47 to have a smaller band gap energy than a p-type cladding layer, as required by claims 1, 7-8 and 14, or to have the lattice matching with and the lower composition of Al than the p-type cladding layer and the higher composition of Al than the active layer as required by claims 15 and 19.

Sasaki is applied for its disclosure of a window layer in view of Hatano's lack of such a layer. It is acknowledged that Sasaki discloses an LED having a window layer. However, as understood, Sasaki, while recognizing the problem of the high potential barrier between the p-cladding layer and the window layer, attempts to solve this problem in an entirely different way from that of the present invention, and lacks any suggestion of the required insertion layer of the present invention. Accordingly, it is respectfully submitted that, even if Hatano disclosed the other required elements of the present invention (which it is respectfully submitted is not the case), the proposed combination of Sasaki with Hatano would be inconsistent with Sasaki's own teachings.

Other features are believed to further and independently distinguish the pending claims over the applied prior art combination. Such features include, for example, the band gap energy of the insertion layer being larger than that of the active layer, as required by claims 2 and 9, and the conductivity type of the required insertion level being of T-type as required by claims 3 and 10.

Also, claims 4 and 11 require that the concentration of the carriers in the p-type insertion layer be within a particular specified range. As best understood, it appears that this limitation has been entirely ignored.

Claims 5 and 12 require that the insertion layer be lattice-matched with the p-type cladding layer. The Examiner asserts that Hatano discloses such lattice matching but fails to identify any supporting disclosure within the Hatano patent.

Claims 7 and 14 require that the active layer be formed of a composition including Al. As described, Hatano's active layer 45 lacks Al. Also required by claims 7 and 14 is that the window

layer be formed of a particular composition as specified. As noted above, Hatano lacks a window layer, and is unclear where the Examiner contends Susaki (even if combinable) discloses any of the recited compositions for a window layer.

Claims 8, 15 and 19 also require that the active layer be formed of a compound semiconductor including Al. As noted above, Hatano's active layer does not include Al.

Claims 17 and 21 require that the p-type cladding and window layers be doped with Zn. Hatano lacks a window layer and explicitly discloses that the p-type clad layers 46-48 are doped with Mg.

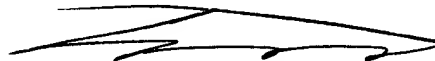
Claims 18 and 22 require a concentration of carriers within a specified range. The Examiner, as understood, points to Hatano's disclosure relating to impurity rather than carrier concentration in support of the rejection.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed local telephone number, in order to expedite resolution of any remaining issues and further to expedite passage of the application to issue, if any further comments, questions or suggestions arise in connection with the application.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 12-0429 and please credit any excess fees to such deposit account.

Respectfully submitted,

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